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**A PARTIAL INVENTORY OF
MICROWAVE TOWERS,
BROADCASTING TRANSMITTERS,
AND FIXED RADAR BY STATES
AND REGIONS**

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service

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BROADCASTING TRANSMITTERS,
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AND REGIONS**



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June 1970

A JOINT REPORT

by

DEPARTMENT OF DEFENSE
Electromagnetic Compatibility Analysis Center
Northern Severn
Annapolis, Maryland 21402

and

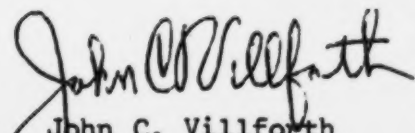
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service
Bureau of Radiological Health
Rockville, Maryland 20852

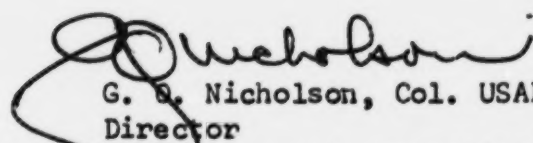
FOREWORD

This report is the result of two Federal agencies joining to produce a mutually beneficial study to provide basic information to support the development of an electronics product radiation control program. Cooperation and a sharing of ideas and goals produced information useful and needed by DOD and HEW in fulfilling Federal government responsibilities under the Radiation Control for Health and Safety Act, Public Law 90-602.

The information produced is intended to be an exploration and presentation of basic data and an inventory for further potential application rather than a conclusive scientific finding. Therefore, we have taken only a very small segment of the electromagnetic spectrum to show the multiplicity of the devices with which we must live in our environment. Furthermore, it should be noted that of the three devices (R/F microwave towers, radio and television broadcast towers, and fixed radar) only those in the microwave range have been shown to be potentially dangerous to man. The effects on man of other frequencies have not been fully determined.

It is our hope this report will be the start of a series showing the relationship to, and effect on man of, the multitude of devices which use the electromagnetic spectrum.


John C. Villforth
Director
Bureau of Radiological Health


G. S. Nicholson, Col. USAF
Director
Electromagnetic Compatibility Analysis Center

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ABSTRACT

This report inventories a small segment of the devices used in the electromagnetic spectrum and indicates their widespread usage. It further indicates the large amount of computerized information, in various files, which is available. Lastly, an appendix provides the reader with a summary of potential biological hazards to man from the many devices used in communications, detection, measurement, medicine, and other fields.

Representative products and manufacturers are named for identification only and listing does not imply endorsement by the Public Health Service and the U.S. Department of Health, Education, and Welfare.

FIGURE

1. U.S. Transcontinental Broadband Microwave Radio Relay Systems..... 3

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A PARTIAL INVENTORY OF MICROWAVE TOWERS,
BROADCASTING TRANSMITTERS, AND FIXED RADAR
BY STATES AND REGIONS

Responsibility for protecting the public health and safety from electronic product radiation was vested in the Secretary of Health, Education, and Welfare by the Radiation Control for Health and Safety Act of 1968 (Public Law 90-602), enacted on October 18, 1968. The Act requires the Secretary to consult and maintain liaison with the Secretary of Defense, and with other officials and agencies, in the development of an electronic product radiation safety program. By delegation of authority, responsibility for day-to-day administration of the Act rests with the Bureau of Radiological Health of the Environmental Health Services.

Responsibilities under the Act include research into, and identification, surveillance, and regulation of ionizing and nonionizing electronic product radiation. Under the Act, the Bureau of Radiological Health has established, or is in the process of implementing, standards for the control of radiation emissions from such electronic devices as television receivers, medical and dental X-ray machines, and microwave ovens. The Bureau is concerned with controlling potentially hazardous radiation emissions from an increasing number of communications and other electronic devices utilizing the electromagnetic spectrum. The Bureau is also concerned with potentially hazardous radiation from fallout, non-AEC licensed radioactive materials, radioactive waste, accelerators, and nuclear powered facilities and devices.

Appendix I of this document is a review by Bureau of Radiological Health staff of biological effects of electromagnetic radiation of concern to this inventory.

Through the years, there has been increased use of the electromagnetic spectrum to meet a continuing and growing demand. The military was the first to feel the impact of this increase. While communications in all forms were proving to be an essential nerve system for a strong and mobile defense structure, the operating requirements of some military forces led to serious problems in interference, particularly within a variety of devices used in a relatively limited geographic area.

By the late 1950's, the Department of Defense had concluded that achieving electromagnetic compatibility among the many users of the radio-frequency spectrum would require more than a simple, prestructured assignment procedure.

Consequently, the Department of Defense established the Electromagnetic Compatibility Analysis Center (ECAC) in 1961 to provide an entirely new engineering approach to the military's unique problems in electromagnetic compatibility. Besides advising and assisting the Secretary of Defense, the Joint Chiefs of Staff, and all components of the Department of Defense, the Center services other Government agencies and civilian activities to the extent of its resources.

During the past 10 years, the need for and useful applications of the spectrum have continued to increase rapidly as new communications-electronics systems led to newer and larger systems. An evaluation of the higher frequency range of the radio spectrum in 1967 showed no evidence, from a theoretical physics standpoint, of the likelihood of overcoming the apparent limit to the use of the spectrum. With the possible exception of the expansion of the spatial dimension of the resource through use of satellites, the usable radio-frequency spectrum has not been significantly enlarged since the early 1950's.

When the Electromagnetic Compatibility Analysis Center entered previously unexplored territory and experimentally developed the systems engineering disciplines, it learned a great deal that contributed to a new era of electromagnetic spectrum management. It was apparent that increasing needs within what is now considered to be a limited resource were creating problems. It was felt we must accelerate evolutionary approaches to meet the challenge of electromagnetic compatibility to accommodate greater use. Inasmuch as the spectrum is overcrowded, a major possibility is to increase the power level of communications channels. This could increase potential biological hazards.

The Public Health Service is working to insure minimum potential radiation danger to the public from the expanded use of the electromagnetic spectrum.

As a beginning, three of the more commonly used electromagnetic devices have been selected for this survey. These are standard broadcasting and television stations, radio frequency microwave towers or common carriers, and fixed radar. The ECAC computer has plotted the location of these devices by State and region as shown in appendix II. Radio broadcast and television, microwave, and radar facilities in terms of low and high frequency and low and high power are contained in appendix III.

By July 1969, the United States had 71,524 microwave towers utilizing 191,517 separate frequencies, or an average of 5.86 frequencies per tower. The demand for better communications is resulting in a 15-percent increase in the number of towers each year. There are 16,272 broadcasting stations in the country. These include AM and FM radio and commercial and educational television. The 2,897 fixed radar devices considered in the inventory include only those used for tracking, identification, communications, and related operations. The above statistics exclude mobile airborne, waterborne, and other vehicular radar devices, as well as classified military communications-electronics installations.

The first commercial communications system using microwave was established in 1945 between New York and Philadelphia. Shortly after World War II, microwave relay stations were used by common carriers to convey commercial communications to the public. By the end of 1965, these facilities had widely expanded as figure 1 indicates. At that time, there were in the United States 80,000 miles of broadband microwave radio-relay systems operating to provide approximately 650,000 one-way radio frequency channel miles. This resulted in serious radio frequency congestion in areas of dense population and in other less populated areas

LINES INDICATE LINE OF SIGHT TOWERS

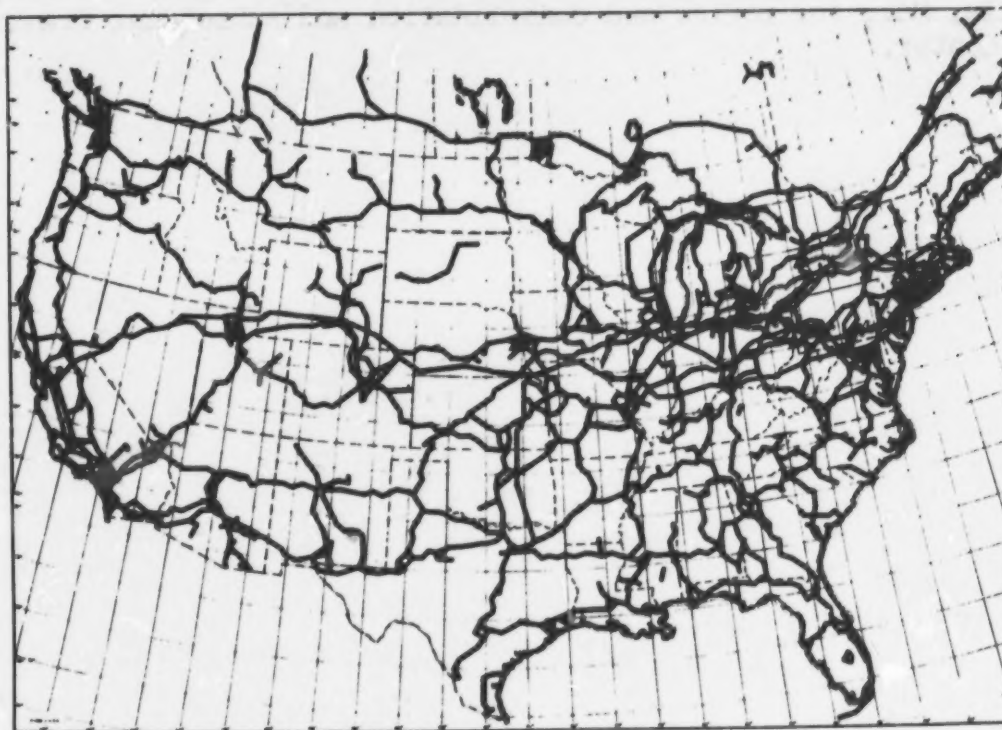


Figure 1. U.S. Transcontinental Broadband Microwave Radio Relay Systems

in which there were heavy route concentrations because of terrain conditions.

Use of frequency bands has been increasing 15-percent a year, posing some serious interference problems. The Joint Technical Advisory Committee report, "SPECTRUM ENGINEERING - THE KEY TO PROGRESS," points out that, because of the band inundation in order to fulfill expanded communications demands, power levels will rise. Whether this added nonionizing radiation will cause potential biological or ecological damage of consequence is under study in the scientific community.

The Public Health Service, in cooperation with other Federal and with State, local and private agencies, is investigating the extent to which electromagnetic communications devices may produce deleterious biological effects, either singly or synergistically.

The Electromagnetic Compatibility Analysis Center has collected and stored comprehensive data on topographic information, communications-electronics equipment, associative surroundings, and technical characteristics of equipment. Analytical solutions of electromagnetic compatibility problems or computer printouts of the parameters as described in appendix IV are available. Requests for such data and services should be forwarded to the Bureau of Radiological Health, Rockville, Md., for review and consolidation and subsequent transmittal to the Center.

Appendix I
POTENTIAL BIOLOGICAL HAZARDS

POTENTIAL BIOLOGICAL HAZARDS¹

Scientific Basis for Standard

A considerable body of evidence demonstrates the potential biological hazard of electromagnetic radiation having a frequency of 30-300,000 MHz (1-5). This range includes frequencies used in microwave ovens. A number of biological effects have been observed following microwave exposure, primarily in studies with animals. These include:

1. Cataract induction.
2. Testicular pathology.
3. Central nervous system effects.
4. Mitotic and chromosomal abnormalities in cells.
5. Alteration in electrophoretic, immunologic and enzymatic activities of proteins.
6. Interference with cellular differentiation in the absence of effect on cellular proliferation.
7. Decreased incorporation of labeled amino acid into liver and testes.
8. Lethality in various animal species.

There is little question, from the foregoing, of the potential hazard of microwaves. It should be noted that a number of the above effects have been observed in the absence of demonstrable increase in body or media temperature, or under conditions which prevented increase of temperature during irradiation. Additionally, in some cases temperature increases of the same magnitude as those produced by irradiation were induced by other means, and the microwave effect was not produced by such heating.

The lowest cataractogenic dose reported by Carpenter, for single exposures, was 120 mW/cm² for 35 minutes. Multiple exposures reduced both the time per exposure necessary to induce cataracts, as well as the intensity of the radiation required for cataractogenesis. The time interval between successive exposures was critical. Thus repeated exposures at 1 day intervals were more effective in producing cataracts

¹Excerpted from "Supplement to Briefing Memorandum on Proposed Performance Standard for Microwave Ovens"

than exposures at intervals of 4 days or longer. The lowest dose capable of producing cataracts was 80 mW/cm^2 with multiple exposures. It should be noted that the latent period for cataract induction was measured in days (6). We have no information on the cumulative effects of exposures administered more frequently than at daily intervals, nor on cataract induction after very long latent periods.

There have been reports of cataracts and lenticular opacities in microwave workers. The lowest exposure, in man, in which a cataract was observed was estimated to be 100 mW/cm^2 , intermittent, over a period of one year (7).

The possibility of cumulative effects of microwave exposure suggested by Carpenter as well as by the work of Russian investigators requires further study. If cumulative effects of microwave exposure do occur, we must accept either that 1) the temperature increases produced by such exposure produced damage that is not completely repaired at the time of subsequent exposure (and we must keep in mind that subsequent exposure means exposure 24 hours or more after the initial exposure), or 2) the damage which was produced by the initial exposure may involve mechanisms other than increase of temperature per se.

In studies on the effects of microwaves on testes, it was observed that the lowest exposure capable of producing minimal changes was 5 mW/cm^2 for 60 minutes (8).

Central nervous system effects have been largely reported by investigators in the U.S.S.R. and include both behavioral studies in humans and pathologic observations in animals. Exposures which produce biological effects range to levels below 1 mW/cm^2 with repeated exposures (Tolgskaya and Gordon (5)). This work has been questioned, particularly since work from the U.S.S.R. is not reported in great detail (4), and there is a lack of direct communication between American and Russian investigators.

Michaelson, Thomson, and Howland have expressed the following (9):

"It should be emphasized that Soviet studies are oriented towards the Pavlovian concept of 'nervism'. This concept presumes that all body responses are influenced by the central nervous system. Experimental support for this approach is obtained by conditional response studies. Experimental studies that rely on conditional responses are subject to criticism because of limited statistical analysis of data, inadequate controls, and difficulty in objective interpretation of the findings. Although the concept of 'nervism' may cloud many experimental or human survey findings, the Soviet position on the biologic effects of microwaves should not be overlooked."

Dr. Susskind is even more emphatic (10): "Some people may believe that Soviet investigators are preoccupied with the conditional-response concept developed by Pavlov and therefore see all biological activity as depending on stimulation of the nervous system; that they see 'athermal' effects where U.S. investigators have seen none. Perhaps it would be more accurate to say that we have scarcely looked for them. We cannot very well dismiss a whole body of scientific literature just because it is Russian. On the contrary, we should seek to duplicate their experiments and provide either corroboration or not."

Thus, work performed in the U.S.S.R. must be given serious consideration until further research will either confirm or reject its substance. Nervous system morphological effects have been observed in the U.S.S.R. at levels as low as 10 mW/cm^2 with multiple exposures (2). These morphological effects can be confirmed or refuted objectively and validly only by further research.

A factor of 10 below 10 mW/cm^2 for safety is not overly conservative for the following reasons:

- 1) We are dealing with an uncontrolled population, and the uncontrolled use of a potentially dangerous source of electromagnetic radiation. For example, food service establishments including restaurants, hospitals, etc. will probably employ operators of microwave ovens that could be exposed repeatedly for many hours per day to microwaves that may emanate from such devices. Further, exposures in such establishments, as well as in homes, could occur under conditions of high ambient temperature and high humidity.
- 2) No control will be possible over the state of health of users. It should be noted that research with animals has employed uniformly healthy subjects.
- 3) The possibility of cumulative effects has been raised by research, and cannot be ignored at this time. Since the potential for exposure of large populations of very young people exists, this raises the question of effects of intermittent repeated exposure over the lifetime of an individual.
- 4) Uncertainty exists over the work of scientists in the U.S.S.R. which can not be easily dismissed unless it is refuted by further research. It should be noted that interaction between low levels of microwaves and the nervous system has been established in this country by the work of Frey, who demonstrated evoked brain stem responses with pulsed microwaves at intensities as low as $30 \text{ } \mu\text{W/cm}^2$ (11). Based on observations of Soviet scientists a standard of 0.01 mW/cm^2 was justified and adopted by the U.S.S.R.

5) Microwaves from ovens are only one source of electromagnetic radiation to which human populations are exposed. Other sources of electromagnetic radiation exist both in the non-ionizing and ionizing frequencies, and the possible biological interactions of multiple electromagnetic radiation insults have not been fully investigated. Further, mankind is exposed to multiple environmental insults including bacterial, viral, and chemical agents, and the complicated interactions of these agents with radiation, including possible synergistic effects, have not been adequately evaluated.

All of these factors would suggest that most serious consideration be given to a maximum level of 1 mW/cm^2 for the protection of public health and safety.

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Appendix II

NUMBER OF ELECTROMAGNETIC DEVICES BY REGION

¹ NUMBER OF ELECTROMAGNETIC DEVICES

43:40:00N-70:20:00W
(280-Mile Radius)

(July 1969)

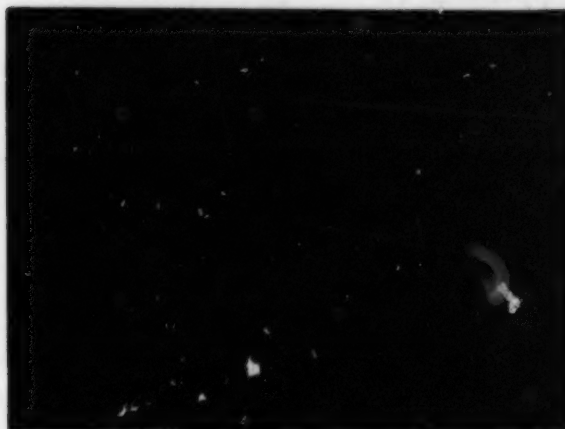
REGION I

Total No. Frequency Bands: 1,724

BROADCAST

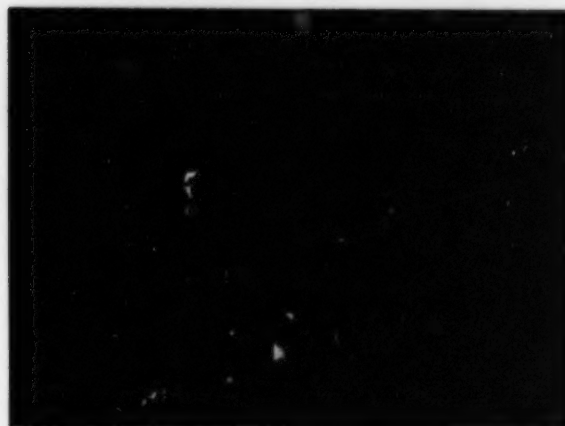
State

No. Records



Connecticut	144
Maine	240
Massachusetts	204
New Hampshire	78
Rhode Island	46
Vermont	59
Total	771

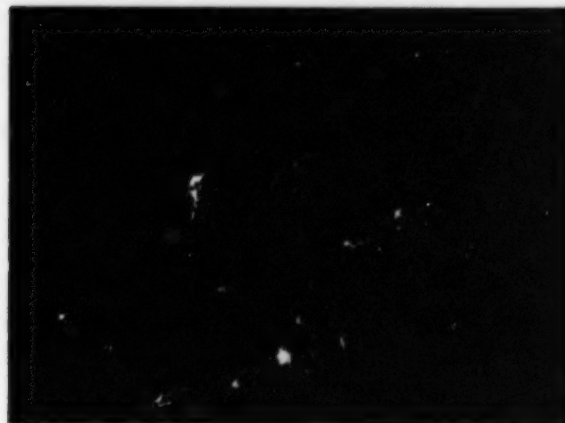
Total No. Frequency Bands: 5,778 MICROWAVE TOWERS



Connecticut	423
Maine	398
Massachusetts	781
New Hampshire	188
Rhode Island	34
Vermont	206
Total	2,030

Total No. Frequency Bands: 362

RADAR



Connecticut	12
Maine	19
Massachusetts	49
New Hampshire	7
Rhode Island	13
Vermont	4
Total	104

¹Excludes classified military installations

NUMBER OF ELECTROMAGNETIC DEVICES (cont.) ¹
(July 1969)

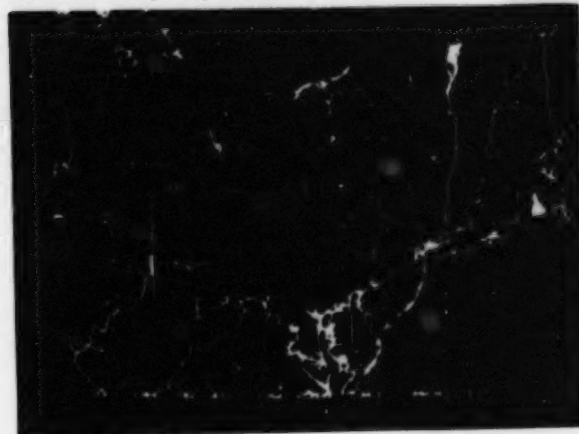
42:00:00N-76:40:00W
 (280-Mile Radius)

REGION II

Total No. Frequency Bands: 2,687

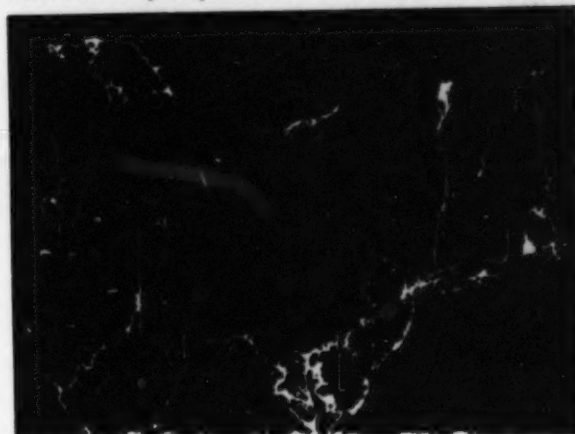
BROADCAST

State No. Records



Delaware	40
New Jersey	191
New York	, 539
Pennsylvania	551
Total	1,321

Total No. Frequency Bands: 12,129 MICROWAVE TOWERS



Delaware	118
New Jersey	1,084
New York	1,736
Pennsylvania	2,815
Total	5,753

Total No. Frequency Bands: 524

RADAR



Delaware	13
New Jersey	102
New York	120
Pennsylvania	60
Total	295

¹Excludes classified military installations

1

NUMBER OF ELECTROMAGNETIC DEVICES (cont.)

37:30:00N-82:20:00W
(420-Mile Radius)

(July 1969)

REGION III

Total No. Frequency Bands: 6,553

BROADCAST

State

No. Records



District of Columbia	49
Kentucky	299
Maryland	168
North Carolina	638
Virginia	392
West Virginia	173
Total	1,719

Total No. Frequency Bands: 29,973 MICROWAVE TOWERS



District of Columbia	46
Kentucky	1,540
Maryland	859
North Carolina	1,717
Virginia	1,863
West Virginia	1,040
Total	7,065

Total No. Frequency Bands: 1,042

RADAR



District of Columbia	17
Kentucky	20
Maryland	37
North Carolina	74
Virginia	95
West Virginia	8
Total	251

¹Excludes classified military installations

1
NUMBER OF ELECTROMAGNETIC DEVICES (cont.)
 (July 1969)

31:10:00N-84:10:00W
 (500-Mile Radius)

REGION IV

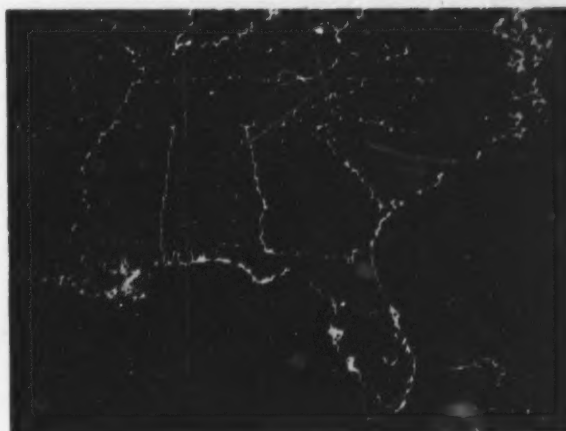
Total No. Frequency Bands: 4,704

BROADCAST



State	No. Records
Alabama	350
Florida	532
Georgia	410
Mississippi	218
South Carolina	245
Tennessee	360
Total	2,115

Total No. Frequency Bands: 23,463 **MICROWAVE TOWERS**



Alabama	1,590
Florida	3,447
Georgia	1,859
Mississippi	1,297
South Carolina	991
Tennessee	1,329
Total	10,513

Total No. Frequency Bands: 867

RADAR



Alabama	55
Florida	194
Georgia	74
Mississippi	67
South Carolina	47
Tennessee	44
Total	481

¹Excludes classified military installations

NUMBER OF ELECTROMAGNETIC DEVICES (cont.)¹
(July 1969)

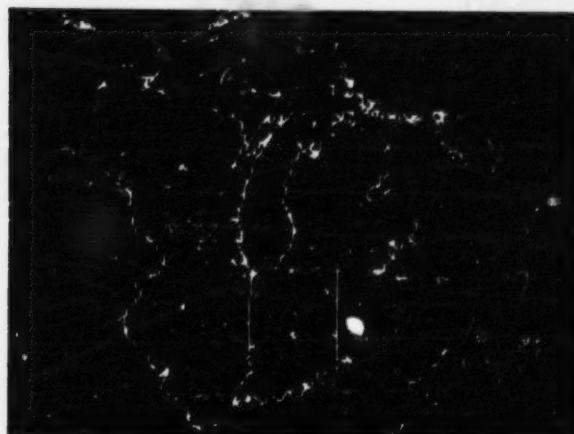
42:25:00N-87:20:00W
(400-Mile Radius)

Total No. Frequency Bands: 4,668

BROADCAST

REGION V

State No. Records



Illinois	439
Indiana	335
Michigan	494
Ohio	427
Wisconsin	373

Total	2,068
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Total No. Frequency Bands: 20,445 MICROWAVE TOWERS

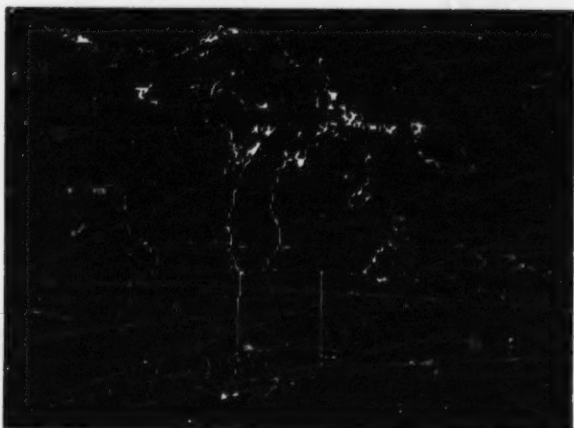


Illinois	3,117
Indiana	2,778
Michigan	1,256
Ohio	2,078
Wisconsin	1,036

Total	10,265
-------	--------

Total No. Frequency Bands: 475

RADAR



Illinois	78
Indiana	26
Michigan	64
Ohio	65
Wisconsin	18

Total	251
-------	-----

¹Excludes classified military installations

NUMBER OF ELECTROMAGNETIC DEVICES (cont.)¹
(July 1969)

42:40:00N-96:15:00W
 (590-Mile Radius)

REGION VI

Total No. Frequency Bands: 6,660

BROADCAST

State

No. Records



Iowa	276
Kansas	262
Minnesota	395
Missouri	341
Nebraska	234
North Dakota	266
South Dakota	177
Total	1,951

Total No. Frequency Bands: 27,753 MICROWAVE TOWERS



Iowa	817
Kansas	1,578
Minnesota	626
Missouri	1,408
Nebraska	1,084
North Dakota	661
South Dakota	380
Total	6,554

Total No. Frequency Bands: 773

RADAR



Iowa	19
Kansas	39
Minnesota	31
Missouri	48
Nebraska	30
North Dakota	25
South Dakota	15
Total	207

¹ Excludes classified military installations

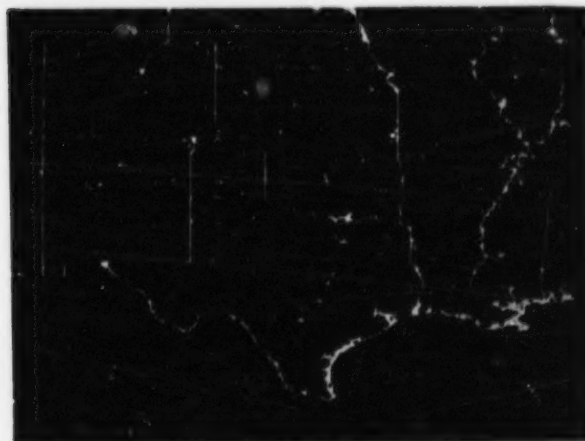
1
NUMBER OF ELECTROMAGNETIC DEVICES (cont.)
 (July 1969)

32:00:00N-99:30:00W
 (6 60-Mile Radius)

Total No. Frequency Bands: 5,450

BROADCAST

REGION VII



State	No. Records
Arkansas	217
Louisiana	240
New Mexico	285
Oklahoma	222
Texas	898
Total	1,862

Total No. Frequency Bands: 26,788 **MICROWAVE TOWERS**



Arkansas	670
Louisiana	2,326
New Mexico	1,314
Oklahoma	1,198
Texas	4,168
Total	9,676

Total No. Frequency Bands: 916

RADAR



Arkansas	23
Louisiana	37
New Mexico	108
Oklahoma	49
Texas	203
Total	420

¹Excludes classified military installations

NUMBER OF ELECTROMAGNETIC DEVICES (cont.)¹
(July 1969)

43:00:00N-109:00:00W
(580-Mile Radius)

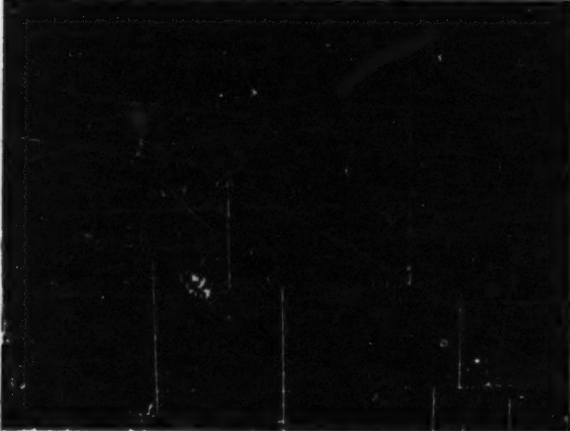
Total No. Frequency Bands: 4970

BROADCAST

REGION VIII

		State	No. Records
		Colorado	451
		Idaho	295
		Montana	326
		Utah	426
		Wyoming	227
		Total	1,725

Total No. Frequency Bands: 22,494 MICROWAVE TOWERS

		Colorado	1,612
		Idaho	862
		Montana	1,433
		Utah	1,595
		Wyoming	924
		Total	6,426

Total No. Frequency Bands: 744

RADAR

		Colorado	42
		Idaho	19
		Montana	25
		Utah	32
		Wyoming	17
		Total	135

¹Excludes classified military installations

NUMBER OF ELECTROMAGNETIC DEVICES (cont.)¹
(July 1969)

39:30:00N-117:00:00W
(740-Mile Radius)

REGION IX

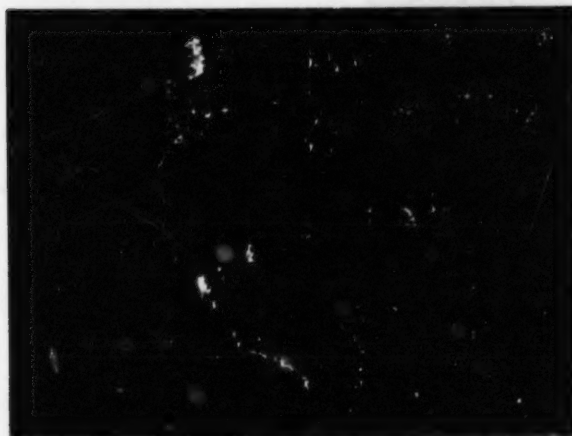
Total No. Frequency Bands: 5,006 BROADCAST State No. Records



*Alaska	61
Arizona	289
California	1,173
*Hawaii	77
Nevada	199
Oregon	422
Washington	519

Total 2,740

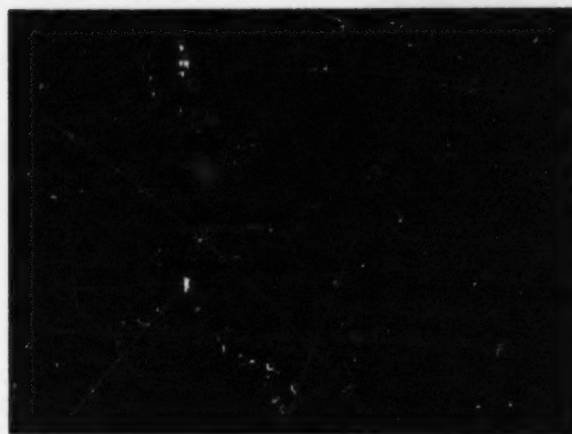
Total No. Frequency Bands: 22,695 MICROWAVE TOWERS



*Alaska	77
Arizona	1,678
California	7,641
*Hawaii	232
Nevada	936
Oregon	1,315
Washington	1,363

Total 13,242

Total No. Frequency Bands: 965 Shown separately RADAR



*Alaska	59
Arizona	53
California	450
*Hawaii	32
Nevada	30
Oregon	51
Washington	78

Total 753

¹Excludes classified military installations

*Shown separately

NUMBER OF ELECTROMAGNETIC DEVICES (cont.)¹
(July 1969)

62:00:00N-147:00:00W
(800-Mile Radius)

ALASKA

Total No. Frequency Bands: 108

BROADCAST

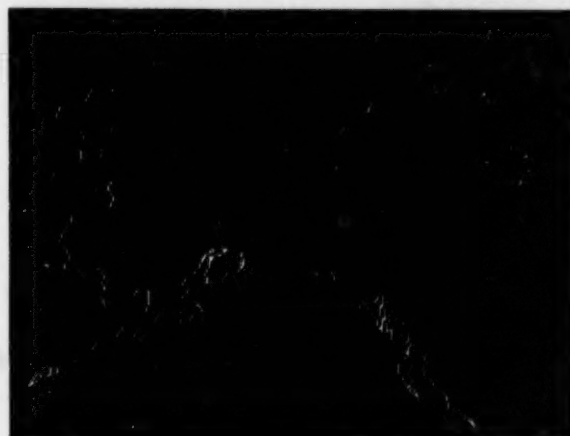
Total No. of Records



61

Total No. Frequency Bands: 156

MICROWAVE TOWERS



77

Total No. Frequency Bands: 45

RADAR



59

¹Excludes classified military installations

1
NUMBER OF ELECTROMAGNETIC DEVICES (cont.)
(July 1969)

21:30:00N-157:00:00W
(200-Mile Radius)

HAWAII

Total No. Frequency Bands: 77

BROADCAST

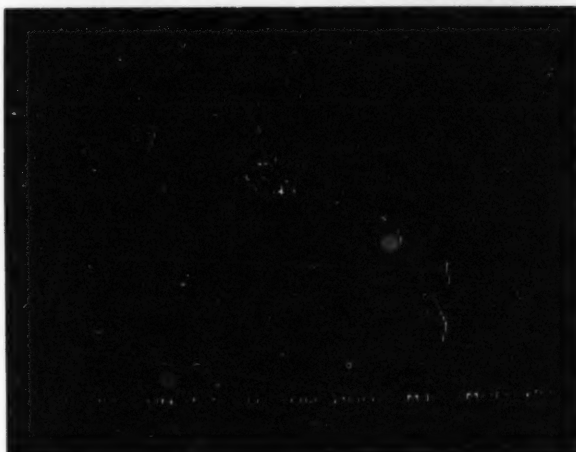
Total No. of Records



77

Total No. Frequency Bands: 232

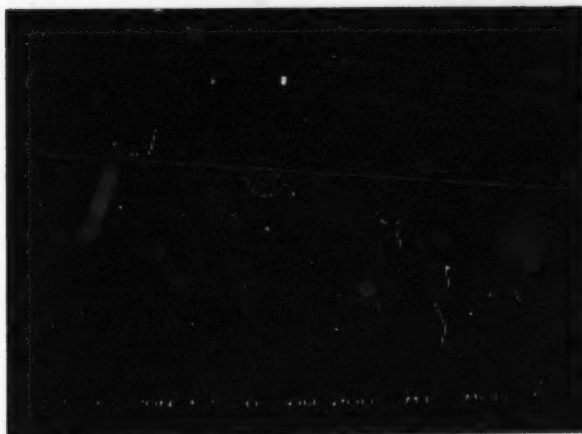
MICROWAVE TOWERS



232

Total No. Frequency Bands: 32

RADAR



32

1Excludes classified military installations

Appendix III

RADIO BROADCAST AND TV, MICROWAVE, AND RADAR FACILITIES
LOW AND HIGH FREQUENCY AND AUTHORIZED POWER

RADIO BROADCAST AND TV FACILITIES LOW AND HIGH FREQUENCY
AND AUTHORIZED POWER

AREA/STATE	MHz		Authorized	
	FREQ. LOW	FREQ. HIGH	PWR LOW	PWR HIGH
<u>Region I</u>				
CONN	.6	7100.	.001	1627
MASS	.56	7100.	.001	1000
ME	.56	13000.	.001	316
NH	.61	7025.	.001	724
RI	.55	7050.	.001	316
VT	.55	7075.	.001	582
<u>Region II</u>				
DEL	.9	6950.	.001	50
NJ	.62	12775	.001	1000
NY	.54	7075.	.001	1000
PA	.54	7100.	.001	1000
<u>Region III</u>				
DC	.63	6887.5	.001	1306
KY	.56	7100.	.001	515
MD	.54	7100.	.001	648
NC	.54	7100.	.001	759
VA	.54	7100.	.001	668.3
WVA	.56	7025.	.001	823
<u>Region IV</u>				
ALA	.56	6875.	.001	675
FLA	.54	10550.	.001	1756
GA	.54	7037.5	.001	836
MISS	.55	7025.	.001	1000
SC	.54	7025.	.001	557
TENN	.54	7050.	.001	655
<u>Region V</u>				
ILL	.56	7100.	.001	1000
INDA	.81	7025.	.001	316
MICH	.56	7100.	.001	1109
OHIO	.55	7100.	.001	1000
WIS	.54	7100.	.001	794

BROADCAST AND TV (continued)

AREA/STATE	MHz		Authorized	
	FREQ. LOW	FREQ. HIGH	PWR LOW	PWR HIGH
<u>Region VI</u>				
IOWA	.54	7025.	.001	500
KANS	.55	7100.	.001	912
MINN	.56	7100.	.001	316
MO	.55	7000.	.001	1280
NDAK	.55	7075.	.001	316
NEBR	.59	7100.	.001	316
SDAK	.57	13100.	.001	316
<u>Region VII</u>				
ARK	.59	7100.	.001	297.9
LA	.54	7037.5	.001	1000
NMEX	.57	7075.	.001	288
OKLA	.64	7075.	.001	316
TEX	.55	12725.	.001	3000
<u>Region VIII</u>				
COLO	.55	13000.	.001	316
IDA	.54	7100.	.001	316
MONT	.55	7025.	.001	316
UTAH	.57	12700.	.001	100
WYO	.93	12800.	.001	230
<u>Region IX</u>				
ALS	.55	6900.	.001	30
ARIZ	.55	7100.	.001	986
CAL	.54	13125.	.001	910
HWA	.55	7025.	.001	77.6
NEV	.63	7100.	.001	64.6
OREG	.55	7100.	.001	468
WASH	.55	7100.	.001	316

BROADCAST AND TV (continued)

	MHz		Authorized	
	FREQ. LOW	FREQ. HIGH	PWR LOW	PWR HIGH
Region I	.55	13000.	.001	1627
Region II	.54	12775.	.001	1000
Region III	.54	7100.	.001	1306
Region IV	.54	10550.	.001	1756
Region V	.54	7100.	.001	1109
Region VI	.54	13100.	.001	1280
Region VII	.54	12725.	.001	3000
Region VIII	.54	13000.	.001	316
Region IX	.54	13125.	.001	986
COMPOSITE	.54	13125.	.001	3000

MICROWAVE FACILITIES LOW AND HIGH FREQUENCY
AND AUTHORIZED POWER

AREA/STATE	MHz		Authorized KW	
	FREQ. LOW	FREQ. HIGH	PWR LOW	PWR HIGH
<u>Region I</u>				
CONN	953.	11684.9999	.0001	.0200
MASS	952.5	12650.	.0001	.0200
ME	955.1	11684.9999	.0001	.0050
NH	3730.	11684.9999	.0001	.0030
RI	3730.	11684.9999	.0001	.0126
VT	1855.	11684.9999	.0001	.0150
<u>Region II</u>				
DEL	1854.2	11684.9999	.0001	.0400
NJ	925.	12630.	.0001	.0150
NY	890.	12689.9999	.0001	.0200
PA	912.	12689.9999	.0001	.0450
<u>Region III</u>				
DC	3730.	6855.	.0001	.0126
KY	952.5	11684.9999	.0001	.0126
MD	953.	12490.	.0001	.0200
NC	954.3	11684.9999	.0001	.0200
VA	953.3	11684.9999	.0001	.0200
WVA	954.7	11684.9999	.0001	.0126
<u>Region IV</u>				
ALA	890.5	12330.	.0001	.0200
FLA	897.3	12539.9999	.0001	.0400
GA	954.9	12650.	.0001	.0200
MISS	953.	11684.9999	.0001	.0450
SC	954.3	12410.	.0001	.0450
TENN	953.3	12449.9999	.0001	.0450
<u>Region V</u>				
ILL	952.5	12609.9999	.0001	.0450
INDA	956.1	12650.	.0001	.0450
MICH	953.1	12650.	.0001	.0126
OHIO	953.	12529.9999	.0001	.0450
WIS	955.4	12570.	.0001	.0150

MICROWAVE (continued)

AREA/STATE	MHz		Authorized	
	FREQ. LOW	FREQ. HIGH	PWR LOW	PWR HIGH
<u>Region VI</u>				
IOWA	954.2	12609.9999	.0001	.0400
KANS	954.8	12510.	.0001	.0200
MINN	955.6	12689.9999	.0001	.0126
MO	953.1	12570.	.0001	.0400
NDAK	953.7	11684.9999	.0001	.0081
NEBR	953.9	12609.9999	.0001	.0200
SDAK	954.8	11684.9999	.0001	.0050
<u>Region VII</u>				
ARK	952.8	12609.9999	.0001	.0100
LA	895.	12490.	.0001	.0450
NMEX	953.	12449.	.0001	.0200
OKLA	895.2	12609.9999	.0001	.0126
TEX	890.5	12689.9999	.0001	.0450
<u>Region VIII</u>				
COLO	953.1	12449.9999	.0001	.0200
IDA	953.	12510.	.0001	.0126
MONT	953.	11684.9999	.0001	.0150
UTAH	953.	12330.	.0001	.0200
WYO	953.	12490.	.0001	.0150
<u>Region IX</u>				
ALS	953.8	6734.9999	.0001	.0200
ARIZ	953.1	12609.9999	.0001	.0200
CAL	890.	12689.9999	.0001	.0250
HWA	789.4	11604.9999	.0001	.0500
NEV	953.7	12430.	.0001	.0180
OREG	895.2	12469.	.0001	.0081
WASH	953.5	11684.9999	.0001	.0190

MICROWAVE (continued)

	MHz		Authorized KW	
	FREQ. LOW	FREQ. HIGH	PWR LOW	PWR HIGH
Region I	952.5	12650.	.0001	.0200
Region II	890.	12689.9999	.0001	.0450
Region III	952.5	12490.	.0001	.0200
Region IV	890.5	12330.	.0001	.0200
Region V	952.5	12650.	.0001	.0450
Region VI	953.1	12689.9999	.0001	.0400
Region VII	890.5	12689.9999	.0001	.0450
Region VIII	953.	12510.	.0001	.0200
Region IX	789.4	12689.9999	.0001	.0081
COMPOSITE	789.4	12689.9999	.0001	.0450

RADAR FACILITIES LOW AND HIGH FREQUENCY AND AUTHORIZED POWER

AREA/STATE	MHz		Authorized KV	
	FREQ. LOW	FREQ. HIGH	PWR LOW	PWR HIGH
<u>Region I</u>				
CONN	996	9375		
MASS	1	34560	.9	500
ME	1012	9375	.4	10000
NH	994	9080	.004	1200
RI	1030	9375	1.5	400
VT	1030	1329	1.	1200
			.5	500
<u>Region II</u>				
DEL	998	34660		
NJ	350	24000	.004	700
NY	500	24000	.5	5000
PA	980	9430	.35	10000
			.5	5000
<u>Region III</u>				
DC	1008	9320		
KY	650	9375	1.1	2000
MD	1030	9375	.35	550
NC	994	9445	.5	4000
VA	222	23800	.5	3500
WVA	1010	2727	.004	5000
			7.	200
<u>Region IV</u>				
ALA	1014	9430		
FLA	70	34512	.5	4000
GA	500	33000	.004	5000
MISS	988	9375	.8	2500
SC	984	9080	1.5	10000
TENN	992	9375	1.5	1400
			.328	4000
<u>Region V</u>				
ILL	998	23800		
INDA	991	9080	.35	4000
MICH	982	9400	1.5	4000
CHIO	980	34650	.004	10000
WIS	990	2700	.024	5000
			.5	4000

RADAR (continued)

AREA/STATE	MHz		Authorized	
	FREQ. LOW	FREQ. HIGH	PWR LOW	PWR HIGH
<u>Region VI</u>				
IOWA	980	5280	1.5	4000
KANS	962	9080	1.5	700
MINN	968	9375	.004	4000
MO	980	34700	.004	4000
NDAK	500	9300	.004	700
NEBR	500	9400	1.5	400
SDAK	982	9080	1.5	400
<u>Region VII</u>				
ARK	990	9080	1.5	750
LA	1006	9080	1.5	4000
NMEX	.25	9400	.4	5000
OKLA	1010	9375	.15	4000
TEX	981	35208	.35	4000
<u>Region VIII</u>				
COLO	500	9300	.004	5000
IDA	500	9300	1.5	400
MONT	1014	9080	.004	500
UTAH	500	9310	.35	10000
WYO	500	9300	1.5	250
<u>Region IX</u>				
ALS	980	9320	1.5	5000
ARIZ	500	9375	.35	4000
CAL	.25	35000	.004	5000
HWA	1019	9375	.9	5000
NEV	500	9310	.015	750
OREG	1018	9410	.2	4000
WASH	650	23800	.004	4000

RADAR (continued)

AREA/STATE	MHz		Authorized	
	FREQ. LOW	FREQ. HIGH	PWR LOW	PWR HIGH
Region I	1.0	34560	.004	10000
Region II	350.	34660	.004	10000
Region III	222.	23800	.004	5000
Region IV	70.	34512	.004	10000
Region V	980.	34650	.004	10000
Region VI	500.	34700	.004	4000
Region VII	.25	35208	.15	5000
Region VIII	500.	9310	.004	10000
Region IX	.25	35000	.004	5000
COMPOSITE	.25	35208	.004	10000

APPENDIX IV

SERVICES AND DATA AVAILABLE FROM THE ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER

The material in this appendix is abstracted from ANALYTICAL SERVICES AND DATA AVAILABLE FROM THE ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER, published by the Center in March 1969.

The Electromagnetic Compatibility Analysis Center maintains several files of data on electromagnetic devices and frequencies in the United States, which are described in detail in this appendix.

The Environmental File shows the use and operation of communications and electronics equipment by various civilian, military and governmental agencies in the 50 United States and other selected areas of the world. Among the agencies included are the Department of Defense, Coast Guard, National Aeronautical Space Agency, Weather Bureau, Office of Emergency Preparedness, Federal Communications Commission, American Telephone and Telegraph, Western Union, and General Telephone and Electronics Company. Outputs from the file can be sorted alphabetically by city or military base, frequency, equipment nomenclature, or a number of other parameters. Major parameters included in the file records are as follows:

Identity number	Modulation types
Security classification	Emission bandwidth
Date of report	Pulse width values
Cognizant military	Pulse repetition rate values
service or agency	Power levels used
Organizational unit name	Frequency and/or frequency
City/Base	range
State/Country	Equipment function
Mobility class	Deactivation date
Number of equipments	Call sign/linkage identifier
Latitude	Antenna vertical beamwidth
Longitude	Antenna horizontal beamwidth
Site elevation	Mainbeam gain
Terrain type	Area of operation
Equipment nomenclature	Activation date
Antenna nomenclature	Image rejection level
Antenna height	Harmonic output level
Antenna elevation angle	IF selectivity
Antenna azimuth or scan	Preselector bandwidth
rate	Output device type
Operating cycle	

The Frequency Allocation Application File consists of information on the frequency allocation status of present and future United States military communications-electronics systems. The file contains detailed data on both the operational and functional features of the systems. The file may be sorted by application number, frequency, operational data, geographical area, operational environment, equipment function, and numerous other major fields and outputs provided accordingly. Major parameters contained in the Frequency Allocation Application File include the following:

- Date
- Title
- Agency
- Status
- Application numbers [include supporting references)
- Security classification
- Function
- Operational environment
- Geographic area of use
- Nomenclature
- Physical installation or platform
- Number of equipments
- Operation date
- Spectrum signature requirement
- Frequency range
- Frequency control method
- Modulation type
- Power
- Pulse width and pulse repetition frequency
- Receiver IF bandwidth
- Antenna beamwidth
- Antenna polarization

The Nominal Characteristics File contains information on the technical characteristics of United States military and civilian communications-electronics systems. The bulk of the information is obtained from military technical manuals and technical orders and from manufacturers' brochures. Special computer programs are used to sort the file on the parameters listed below and produce output listings.

Output tube type	Electrical tilt angle range
Peak power output	Vertical beamwidth
Average power output	Number of mainbeams
Frequency range	Reflector dimension
Pulse width capability	Vertical antenna scan rate
PRF capability frequency	Sector scan limits
FM-CW deviation radio	Horizontal scan rate
Emission bandwidth	Elevation angle range
Rise time	Raster scan - number of bars
Decay time	Angle tracking bandwidth
First IF	Angle tracking open loop gain
First IF selectivity	Range tracking bandwidth
Second IF	Range tracking open loop gain
Second IF selectivity	Velocity tracking bandwidth
Third IF	Velocity tracking open loop gain
Third IF selectivity	Frequency generation scheme
Sensitivity	Base bandwidth
Noise figure	Harmonic output level
Antenna type	Preselector selectivity
Antenna lead type	Image rejection level
Antenna feed type	Antenna lead cutoff frequency
Reflector shape	Polarization
Fundamental antenna gain	Detector type
Horizontal beamwidth	Special circuitry remark

The Spectrum Signature File consists of reports on measurements conducted on radar and communications equipment. Spectrum signature measurements are obtained by the military departments. The measurements are used principally to augment theoretical knowledge in development of mathematical models representing communications-electronics systems. They are also used in conjunction with solutions of specific problems. ECAC does not distribute spectrum signature reports externally although data extracts can often be made available on request. Parameters measured are:

- Power output
- Emission spectrum characteristics
- Modulation characteristics
- Transmitter intermodulation
- Modulator bandwidth
- Carrier frequency stability
- Sensitivity
- Selectivity
- Spurious response
- Overall susceptibility
- Receiver modulation
- Standard response
- Receiver intermodulation
- Pulse and CW desensitization
- Adjacent signal interference
- Dynamic range
- Oscillator radiation
- Audio selectivity
- Discriminator bandwidth
- Antenna measurements
- Antenna patterns

The ECAC Topographic File consists of terrain elevation data extracted from standard Army Topographic Command maps. Elevation data are in feet and the coordinate system conforms to the latitude/longitude grid system. Outputs from this file are used to determine line-of-sight conditions between equipments and as input to propagation path loss calculation models which are dependent on a knowledge of path profiles.

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